

I claim:

1. A modulation method for multiple-tone signalling using a system with an analogue front end, comprising the steps of:

5 feeding a symbol data stream of multiple tone symbols to a model and to a buffer for onward transmission to the analogue front end;

in the model, modelling the peak amplitude that will be present in the symbol data stream after subsequent processing by the analogue front end;

10 feeding forward a control signal based on the modelled peak amplitude from the model to the analogue front end; and

outputting the symbol data stream from the buffer through the analogue front end under the control of the control signal.

15 2. A method according to claim 1 wherein the analogue front end includes an amplifier operable from a plurality of different voltage levels, and wherein the control signal selects one of the plurality of different voltage levels in the amplifier.

20 3. A method according to claim 1 including preprocessing the symbol data stream in the analogue front end, and modelling the preprocessing in the model.

25 4. A method according to claim 3 wherein the modelling is carried out separately on each symbol.

5. A method according to claim 4 further comprising processing an input data stream through a plurality of intermediate processing stages and corresponding stages of intermediate data to generate the symbol data stream; and

30 if the modelled peak amplitude in a particular symbol in the symbol data stream exceeds a predetermined threshold, amending predetermined intermediate data such that the input data is still represented by the

intermediate data, carrying out the subsequent intermediate processing stages on the intermediate data to regenerate the particular symbol in the symbol data stream, and replacing the particular symbol with the regenerated symbol.

5 6. A multiple tone modem comprising:

 a modulator for generating a symbol data stream of multiple tone symbols;

 an analogue front end for processing the symbol data stream, the analogue front end including a digital to analogue converter and a line driver
10 for driving a line; and

 a model for processing the symbol data stream to predict the amplitude peaks present in the symbol data stream after subsequent processing by the analogue front end and for feeding forward a control signal based on the modelled amplitude peaks to the analogue front end;

15 wherein the analogue front end includes a control input for accepting the control signal and the analogue front end processes the symbol data stream under the control of the control signal.

 7. A multiple tone modem according to claim 6 wherein the
20 analogue front end includes a line driver connected to a plurality of different power supply voltage levels and the control signal selects one of the power supply voltage levels based on the amplitude peaks in the symbol data stream.

 8. A multiple tone modem according to claim 6 further comprising a
25 data buffer between the modulator and the analogue front end.

 9. A multiple tone modem according to claim 6 wherein the analogue front end further comprises a preprocessing module for preprocessing the symbol data stream, and wherein the model models the
30 preprocessing.

10. A multiple tone modem according to claim 8 wherein the model models the peak amplitude separately for each symbol in the symbol data stream.

5 11. A multiple tone modem according to claim 10 wherein:

the modulator includes a plurality of intermediate processing stages for processing an input data stream through a plurality of stages of intermediate data and generating the symbol data stream; and

10 the modulator further comprises a regeneration control system actuated if the modelled peak amplitude in a symbol exceeds a predetermined threshold to amend predetermined intermediate data such that the input data is still represented by the intermediate data, and to carry out the subsequent intermediate processing stages on the amended intermediate data to regenerate a replacement symbol.

15 12. A computer program product for controlling a modulator connected to an analogue front end; the computer program product adapted to cause the modulator to carry out the steps of:

processing a symbol data stream of multiple tone symbols;
20 modelling the amplitude peaks that will be present in the symbol data stream after subsequent processing by the analogue front end; and
generating a control signal based on the modelled amplitude peaks from the model for controlling the analogue front end.

25 13. A computer program product according to claim 12 adapted to cause the modulator to carry out the further steps of:

processing an input data stream through a plurality of intermediate processing stages and corresponding stages of intermediate data to generate the symbol data stream; and
30 if the modelled peak amplitude in a particular symbol in the symbol data stream exceeds a predetermined threshold, amending predetermined intermediate data such that the input data is still represented by the

intermediate data, carrying out the subsequent intermediate processing stages on the intermediate data to regenerate a symbol in the symbol data stream, and replacing the particular symbol with the regenerated symbol.

- 5 14. A multiple tone transmission system comprising:
 - a transmitter including
 - a modulator for generating a symbol data stream of multiple tone symbols;
 - an analogue front end for processing the symbol data stream, the
 - 10 analogue front end including a digital to analogue converter and a line driver for driving a line; and
 - a model for processing the symbol data stream to predict the amplitude peaks present in the symbol data stream after subsequent processing by the analogue front end and for feeding forward a control signal based on the
 - 15 modelled amplitude peaks to the analogue front end; and
 - wherein the analogue front end includes a control input for accepting the control signal and the analogue front end processes the symbol data stream under the control of the control signal;
 - further comprising a transmission line; and
 - 20 a receiver connected to the transmission line to decode the transmitted data stream.